VII. What is Arizona Doing about Water Quality Problems?

Water quality protection programs are based on federal and state laws, which provide a framework for comprehensive water quality protection. Three federal and state regulations provide the foundation for protecting Arizona's water resources:

- **The federal Clean Water Act –** establishes a national goal to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. This act was amended in 1987 to include state nonpoint source management programs that address reduction of pollution associated with activities that do not have end-of-pipe discharge points and can have discharges that are dispersed over large areas (e.g., agriculture, urban runoff).

- **The federal Safe Drinking Water Act --** requires that states develop programs to protect surface and ground water used for public drinking water systems through source water protection programs, and to ensure the delivery of safe water to these public systems.

- **The Arizona Environmental Quality Act –** gives ADEQ authority to develop state environmental protection programs for both surface and ground water that are not mandated under the federal acts (e.g., Aquifer Protection Permits, drywall registration, Pesticide Contamination Program, installation and remediation of Underground Storage Tanks and ground water monitoring).

Arizona's water quality protection programs are summarized in **Appendix E**. Further information about these programs can be obtained at ADEQ's web site: http://www.adeq.state.az.us

This section will discuss the following programs established to identify and mitigate water quality problems in Arizona:

- The monitoring program,
- The Total Maximum Daily Load Program,
- Remediation Programs (Superfund and others), and
- Arizona's Mexican Border Program.

ADEQ's watershed approach provides opportunities for direct public involvement in mitigation activities, and better coordination of water quality and quantity improvement programs (see discussion in Volume II).

How to assess a big state with limited resources

Arizona's Comprehensive Monitoring Program – A variety of monitoring techniques are used to provide comprehensive statewide water quality assessments of perennial surface waters and ground water. This includes a combination of targeted and statistically-based monitoring designs. To monitor perennial surface waters, ADEQ looks at water chemistry, chemical concentrations in fish tissue, bioassessments of macroinvertebrate community, and physical-habitat conditions. At this time, assessments are primarily based on the water chemistry.

The lack of flowing water in ephemeral and some intermittent surface waters, greatly limits the possibility to monitor or assess these waters. New assessment tools (e.g., contaminated sediment or physical integrity standards) will need to be developed before these waters can be routinely monitored and assessed. Although ADEQ has been working on physical integrity criteria for several years, it will take several more years before the physical integrity data can be used definitively for assessments.

Developing bioassessment criteria has also been a high priority during the past 10 years. It is anticipated that narrative implementation procedures or numeric standards will be developed before the next assessment that will facilitate assessments based on narrative standards including biocriteria and habitat assessments.

Thus far, statistically-based or probability-based monitoring design, encouraged by EPA, has <u>not</u> been employed by Arizona. Inferring water quality assessments for a watershed or entire state based on samples collected at a few (i.e., 30 sites) does not appear to be applicable in a state with limited and discontinuous perennial flows and a high diversity of geologic and ecologic conditions. This type of monitoring generally relies on a larger variety of assessment tools than Arizona has developed, such as bioassessments, habitat assessments, and toxicity testing.

A number of focused monitoring programs are integrated to create Arizona's comprehensive monitoring program. The location of a sample site, the frequency of monitoring, the parametric coverage, and the monitoring protocols are critical design factors in accurately determining water quality. These are

primarily determined by the sampling objective. The monitoring objective for each of ADEQ's monitoring programs is described below.

Ambient Surface Water Monitoring – The objectives for this program are:

- Characterize water quality across a region (normally a watershed),
- Determine whether perennial streams and lakes are attaining numeric and narrative surface water quality standards and identify standards not being met;
- Determine long-term reference conditions to support bioassessments and antidegradation policy;
- Identify long-term trends in water quality; and
- Characterize the trophic status of lakes and reservoirs.

The following monitoring programs are involved in this type of monitoring:

- Watershed characterization monitoring -- Representative sampling sites are selected within a watershed to provide information about perennial streams in the targeted watersheds, and where appropriate, the quality of water entering Arizona from other states or Mexico. Analytical suites are collected at each site quarterly for one year (see analytical suite description in the text box). Where appropriate, macroinvertebrate community and physical habitat measurements are also collected.
- Ambient lake monitoring – Lakes are sampled on a quarterly basis for one year for the analytical suite and for indicators of over-enrichment. Multiple sampling sites and depth profiles (measurements at one meter intervals) are used to characterize water quality. Because nutrient over-enrichment is a problem at most lakes (although not the major river reservoirs), monitoring is often focused on the four basic indicators of over-enrichment: total phosphorus, total nitrogen, algal chlorophyll and Secchi depth.
- Reference condition monitoring – These long-term sites characterize regional, least disturbed conditions to support bioassessments or other analysis. Macroinvertebrate bioassessment reference sites are monitored during the spring when macroinvertebrate communities should be thriving, and because the warm and cold water Index of Biological Integrity were derived based on monitoring only during this season. Analytical suites are also collected at these sites.
- Unique Waters monitoring – These sites provide baseline water quality conditions to determine statistically-significant changes in water quality. This monitoring occurs in waters classified or proposed as Unique Waters as part of the ambient stream watershed monitoring or as part of a special investigation in support of a proposed listing. Analytical suites are collected at these sites quarterly to determine seasonal variation.
- Long-term trend monitoring -- Fixed long-term sites are monitored to determine trends in water quality **(Figure 27)**. Trend sites, representative of water quality throughout a stream, lake, or watershed, are monitored quarterly every year for a minimum of 10 years. Analytical suites are collected at these sites. Macroinvertebrate samples are not usually collected. ADEQ contracts with USGS to assist in monitoring some of these sites.

Analytical Suite

Analytes being tested will vary based on the monitoring purpose. The following suite of analytes are collected at ambient monitoring sites:

Field data: Dissolved oxygen, pH, specific conductance, stream flow, turbidity, air temperature, water temperature, site characteristics, photographs. For lakes add redox, secchi depth, depth (not flow), and chlorophyll a.

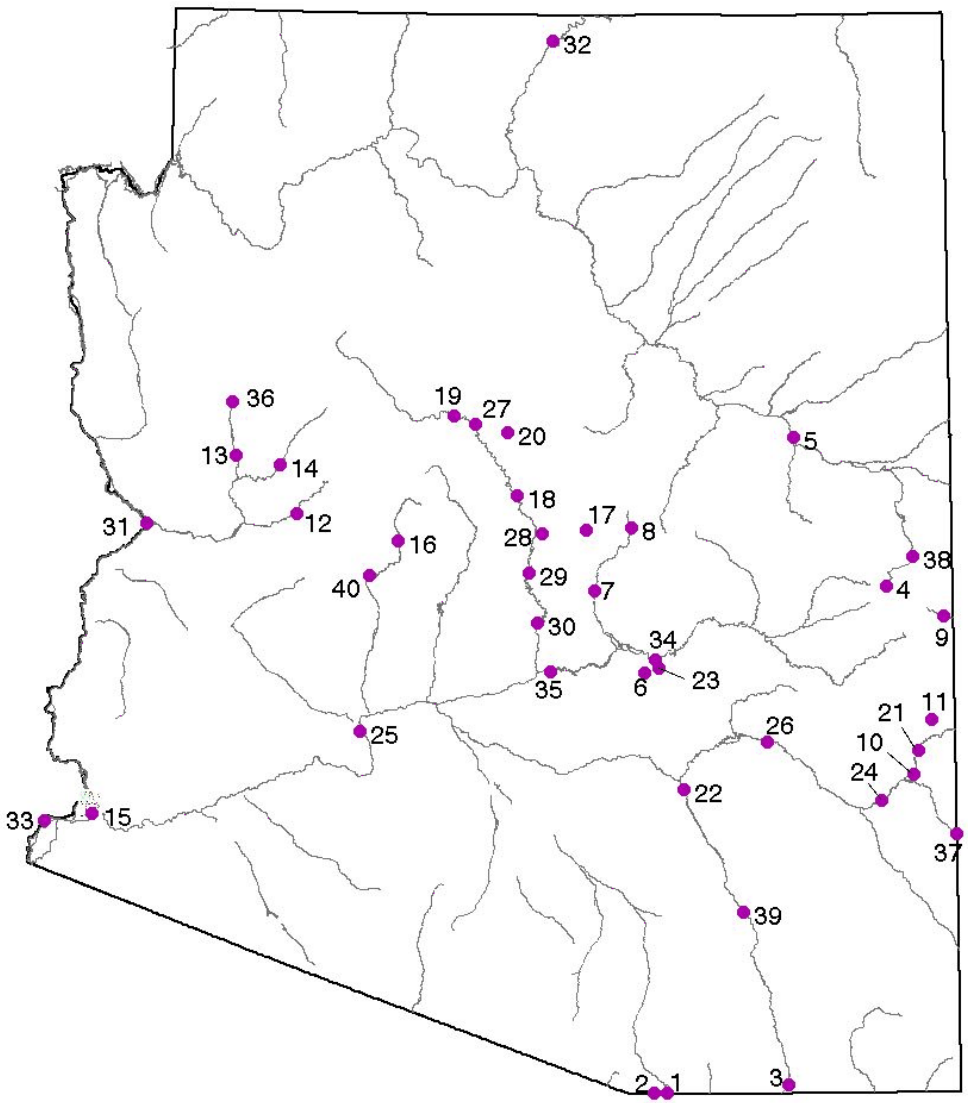
General chemistry: Specific conductance, pH, calcium, magnesium, sodium potassium, chloride, sulfate, fluoride, turbidity, total dissolved solids, total suspended solids, hardness, carbonate, bicarbonate, alkalinity (total and phenolphthalein). For lakes add chlorophyll a and algae identification.

Nutrients: Ammonia (as nitrogen), phosphorus (total as phosphorus), nitrate/nitrite (total as nitrogen), total Kjeldahl nitrogen.

Metals (total and dissolved): Antimony, arsenic, barium, beryllium, boron (total), cadmium, chromium, copper, iron (total), lead, mercury, manganese (total), nickel, selenium, silver, thallium, zinc.

Bacteria: Fecal coliform and *Escherichia coli*. (In lakes, collecting only *Escherichia coli*).

In addition, suspended sediment concentration will be collected at all future ambient sites.



#	Stream	Description
1	Santa Cruz River	at Mexican border
2	Nogales Wash	in Nogales, AZ
3	San Pedro River	at Palominas
4	West Fork Little Colorado	at Government Springs
5	Little Colorado	at Woodruff
6	Pinto Creek	at Henderson Ranch
7	Tonto Creek	above Gun Creek
8	Tonto Creek	below Christopher Creek
9	San Francisco River	above Luna Lake
10	San Francisco River	below Clifton
11	Blue River	at Juan Miller Road
12	Santa Maria	at Highway 93
13	Big Sandy	at Highway 93
14	Burro Creek	below Boulder Creek
15	Gila River	near Dome
16	Hassayampa	near Wagoner
17	East Verde River	at highway 87
18	Verde River	at Beasley Flat
19	Verde River	at Perkinsville
20	Oak Creek	at Red Rock Crossing
21	San Francisco River	above Clifton
22	San Pedro River	Nature Conservancy
23	Pinal Creek	at Inspiration Dam
24	Gila River	head of Safford Valley
25	Gila River	above Gillespie Dam
26	Gila River	at Calva
27	Verde River	near Clarkdale
28	East Verde River	near Childs
29	Verde River	below Tangle Creek
30	Verde River	below Bartlett Lake
31	Colorado River	below Parker Dam
32	Colorado River	at Lee's Ferry
33	Colorado River	at Northern Mexican border
34	Salt River	near Roosevelt Lake
35	Salt River	below Stewart Mountain Dam
36	Trout Creek	near Wikieup
37	Gila River	at Old Safford Bridge
38	Little Colorado River	near Springerville
39	San Pedro River	at Cascabel
38	Hassayampa River	at Box Canyon

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Targeted Surface Water Monitoring -- This monitoring program focuses on waters where pollution is suspected or known to exist. The frequency and types of constituents monitored are project-specific. The objectives of this monitoring are to:

- Determine whether exceedances are persistent or recurring, and if so,
- Determine the probable extent of contamination, critical flow, climatic or seasonal conditions, and sources.

Targeted monitoring is conducted by several programs within ADEQ, including:

- TMDL Program monitors surface waters on the 303(d) List of impaired waters. Monitoring is used to determine sources of the pollutant, critical conditions, extent of the contamination, and appropriate mitigation strategies.

- The new Targeted Sampling Program will monitor waters on the Planning List that have insufficient current credible data to make an assessment. This program will also be coordinated with the TMDL monitoring team to evaluate the effectiveness of TMDL strategy implementation. The targeted monitoring team will collect samples at the original monitoring site, as well as upstream and downstream of the site, during critical flow and climatic or seasonal conditions related to the previous exceedances. The frequency and type of monitoring data collected will be determined on a site-by-site basis.

- The Priority Pollutant Program primarily monitors fish tissue and sediment for pollutants that bioaccumulate and may pose a significant human-health or ecological risk.

- Complaint, compliance, and special investigations monitoring, done in conjunction with ADEQ's Enforcement Team is triggered by citizen complaint, permit violations, and potential for contamination due to discharges of contaminants.

- Effectiveness monitoring sites are selected to determine the success of implementing Best Management Practices, permit limits, or other
- Watershed characterization monitoring -- To maximize the quantity and quality of data available for assessments, ADEQ focuses its resources on an intensive survey of two watersheds per year (generally a wetter and drier watershed are paired) while maintaining a statewide fixed station network. A five-year rotating schedule has been established so that every year two of the ten watersheds will be more intensively monitored. Generally, 15 to 20 monitoring sites are selected within each watershed on perennial waters to characterize water quality. The watershed schedule is shown in **Table 29.**

mitigation actions within a watershed. This includes monitoring to determine effectiveness of TMDL strategy implementation. Baseline monitoring is needed prior to implementation to determine natural concentration and variation in the parameter of concern and to allow a statistically-based assessment of effectiveness.

How Are Surface Water Monitoring Sites Selected? – Site selection will depend on the objectives of the monitoring program but all sites are selected to be representative of water quality conditions within the stream or lake. Where possible, ambient monitoring sites are at or near US Geological Survey or other agency discharge gaging stations so there will be continuous stream flow records at the sample site. ADEQ's ambient monitoring sites are typically selected to be in perennial, wadeable surface waters.

Lake sampling sites are selected based on lake size and lake morphology. Lakes with less than 20 acres generally have a minimum of one sample location near the dam, near maximum depth. Sites for larger lakes, or lakes with complex morphology, are chosen to represent the varying conditions within the lake.

Access limitations must be considered. Steep canyon walls, lack of roads or trails, or obstacles to rafting make some sites inaccessible or impractical considering the amount of monitoring equipment that must be transported to and from the site. In addition, private ownership of the shoreline or part of the access road may make the site inaccessible.

Site selection protocols for each ADEQ monitoring program are defined in quality assurance plans and sampling analysis plans. General criteria are also included in published protocol documents.

Scheduling and Prioritizing Monitoring – Over the next few years, the targeted monitoring team will focus its effort on monitoring waters listed on the Planning List. Prioritization and long-term scheduling will be essential as the first Planning List is extensive and ADEQ wants to maintain its other monitoring programs. It will be necessary to coordinate with other agencies (e.g., USGS, US Fish and Wildlife Service, National Parks Services, AZ Game and Fish Dept).

Table 29. Arizona's Watershed Schedule

Watersheds	Focus Years
Salt and Middle Gila	2002, 2007
Colorado-Lower Gila and Bill Williams [Verde and Bill Williams starting in 2008]	2003, 2008
Verde and Colorado-Grand Canyon [Colorado-Lower Gila and Colorado-Grand Canyon starting in 2009]	1999, 2004, 2009
San Pedro-Willcox-Rio Yaqui and Upper Gila (San Carlos-Safford-Duncan)	2000, 2005, 2010
Little Colorado-San Juan and Santa Cruz-Rio Magdalen-Rio Sonoyta	2001, 2006, 2011

. Prioritization of the 303(d) List – As discussed in more detail in Chapter V, the priority for completing a TMDL is established for each surface water on the 303(d) List. As established in the Impaired Waters Identification Rule **(Appendix B)**, that ranking reflects the relative value and benefits of the surface water as well as the potential threat to human health, aquatic life, and wildlife. High, medium, and low priorities can be summarized as follows:

High priority:

- Threat to human health, aquatic life, or wildlife as judged by:
  a. Issuance of a beach closure, fish consumption advisory, drinking water advisory, fish kills;
  b. The number of designated uses impaired;
  c. The potential risk based on the type of pollutant(s) causing the impairment. (For example, bacteria, toxic chemicals, chemicals with a potential for bioaccumulation being more of a concern than other pollutants); and
  d. Magnitude of the impairment. (For example, if pollutant concentration level is at twice the standard).
  e. Duration of impairment.
- Possibility of a NPDES / AZPDES permit issuance being delayed until the TMDL is completed;
- Surface water is protected by a special designation by the state or federal agency (e.g., Unique Water, Wilderness, etc.)
- Surface water contains a federally listed Threatened or Endangered Species and the pollutant of concern is likely to jeopardize the listed species;
- Delay in conducting the TMDL could jeopardize ADEQ's ability to gather sufficient credible data;
- Degree of public interest and support for developing the TMDL;
- Water has an important economic or recreation significance to the public; or
- Length of time that the surface water has already been on the list as all TMDLs must be completed within 15 years of their first listing (using the 1998 list as the first list in this case);

Medium priority:

- Pollutant of concern exceeds more than one standard or impairs more than one designated use;
- TMDL is complex due to seasonality of impairment, nature of pollutant, or involvement of other states or nations;
- Regulatory controls or other actions should result in attainment of water quality standards, but may take more than 2 years; or
- Administrative needs of the Department.

Low priority:

- Surface water has been proposed for delisting;
- A change in a water quality standard or designated uses has been formally submitted to EPA that would result in attainment of standards;
- Regulatory controls or other actions should result in attainment of water quality standards within 2 years;
- Surface water is ephemeral or intermittent and does not contribute to impairment of a downstream perennial surface water;
- Pollutant poses a low ecological or human health risk:
- A lot more data are needed to base a TMDL;
- International or interstate issues;
- Natural background conditions are a major source of impairments; or
- Proper technical tools to develop a TMDL are not available.

TMDLs will be initiated within the first two years following the list being approved by EPA for surface waters identified as "high priority." All other waters ranking medium or low priority have been scheduled to begin development of the TMDL within the next 5-year watershed cycle. The 303(d) List in Chapter V identifies the priority ranking, the schedule for initiating a TMDL, and the status of any TMDL already in progress. The fact that Arizona is in the fourth year of a drought poses an additional obstacle that may delay obtaining sufficient data during

critical conditions for completing TMDLs as scheduled.

· Prioritization of the Planning List – The factors used to prioritize TMDLs are also relevant to the Planning List, except that no designated uses have been assessed as "impaired." In addition to those factors identified above, Planning List prioritization considers:

- The number of exceedances compared to the number of samples taken, and the potential for completing the sample collection necessary to make an assessment;
- Whether there are critical conditions (season, precipitation, activity in the watershed) when exceedances occur, and schedule sample collection so these conditions are represented;
- Watershed management rotation, when listed due to insufficient data rather than exceedances;
- Development of comprehensive watershed management plans; and
- Whether a surface water was previously on the 303(d) List for this pollutant, so that sampling could look for critical conditions when exceedances occur.

The TMDL statute precludes the placement of any surface water on the 2002 303(d) List that does not meet the requirements of the new Impaired Waters Rule. This has resulted in a number of surface waters, previously on the 1998 303(d) List being moved to the 2002 Planning List. These waters will also be prioritized for monitoring by either the ambient monitoring team, as part of the watershed rotation monitoring, or the targeted monitoring team.

Targeted surface waters with an overall ranking of high would be scheduled for monitoring in the two years following issuance of the 303(d) List. Medium or low priority waters would be addressed in the subsequent three years with the objective of having sufficient monitoring data on all waters on the Planning List within the current five-year watershed cycle. The current drought in Arizona may also delay obtaining sufficient data during critical conditions on some waters on the Planning List.

How Does ADEQ Assure Data Quality? – Data used in assessment and listing must be evaluated to determine whether it meets the credible data requirements of the newly adopted Impaired Waters Identification Rules (A.A.C. R18-11-602). To assure that the data is credible and relevant, all water quality data are collected using a suitable Quality Assurance Plan (QAP) and site-specific Sampling and Analysis Plan (SAP) or equivalent planning documents. Chemical and toxicological samples must be analyzed in a state-licensed laboratory, federal laboratory, or other laboratory that can demonstrate procedures that are substantially equal to those required by the Arizona Department of Health Services and use methods identified in A.A.C R9-14-610.

QAPs and SAPs

A **Quality Assurance Plan** details how environmental data collection and analyses are planned, implemented, and assessed for quality during the monitoring project.

A **Sampling and Analysis Plan** describes where, why, and how samples are to be collected to ensure that data quality objectives are met and that samples are spatially and temporally representative of surface water conditions.

Because surface water assessments are used to decide whether a surface water is impaired, these requirements apply to all data used in this assessment. These documents must specify the use of accepted field and laboratory methods by adequately trained staff. ADEQ has QAPs and associated SAPs for each of its monitoring programs that are available for reference by other monitoring entities.

Adequate training of field and laboratory personnel is essential. ADEQ, in conjunction with Arizona Department of Health Services, provides classes in field monitoring techniques. Several community colleges and universities also offer classes in environmental sampling techniques.

The data are reviewed for accuracy and to determine whether all data points are valid. Questionable data is flagged and eliminated from the assessment process until it can be validated.

Some data was included in the monitoring tables in Volume II that did not meet the new credible data requirements. As noted in the tables, this data was not used for the final assessments, but they were included as reference information.

How Does ADEQ Track Monitoring Data? – Surface and ground water data is stored in ADEQ's Water Quality Database and uploaded to the federal STORET database. Data uploaded to the STORET database can be easily queried on the internet at: http://www.epa.gov/STORET ADEQ's Oracle based system is the repository of all water chemistry data collected by ADEQ and by other monitoring entities under contract by ADEQ. Eventually, all water quality data used in assessments will be stored in this database.

The groundwater portion of the database provides a comprehensive repository for well location information, well construction details, field measurement data (e.g., aquifer water levels), field observations (e.g., borehole geology), and water quality sampling results. The surface water portion stores sampling site information, field observations and measurements, and water quality sampling results. Further information concerning the Oracle database can be obtained by calling Wayne Hood, Data Management and Analysis Section Manager at (602) 771-4427.

Information about the data used for surface water assessments is provided in Volume II, the watershed section of this report. The agency monitoring, number of samples, years sampled, and constituents exceeding standards are summarized in these tables.

What happens after a surface water is assessed as "impaired?"

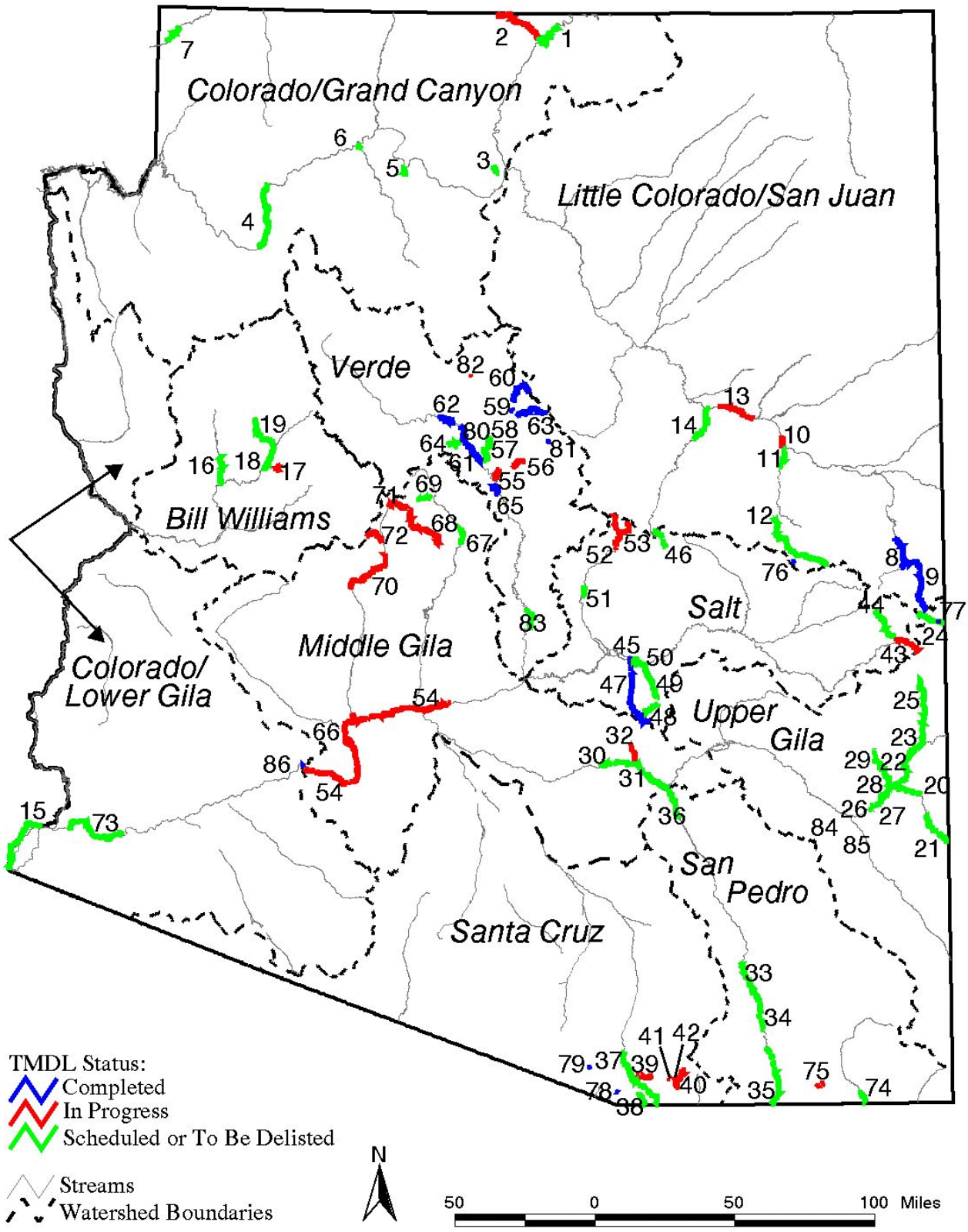
The federal Clean Water Act requires states and EPA to develop Total Maximum Daily Loads for any surface water identified as impaired. These water quality limited waters are placed on the federal 303(d) List.
The purpose of a TMDL is to identify the sources and quantities of pollutants being delivered to a surface water, and to identify the maximum loading of a pollutant from each source which the surface water can assimilate and still meet a water quality standard. To make a TMDL more than just a modeling exercise, strategies must be identified and implemented that can effectively and economically meet the maximum loads identified and bring the surface water back into compliance with established water quality standards.

The development of a scientifically sound and publicly acceptable TMDL is complicated and resource intensive. It requires significant staff resources, funding for laboratory analyses of water quality samples, computer-based hydrologic modeling of watersheds, and a well coordinated and effective program to involve affected watershed stakeholders as well as other state and federal resource management agencies. Development of a TMDL can take from six months to several years depending on the size and hydrologic complexity of the watershed, severity of the impairment, behavior of the pollutant, number and distribution of pollutant sources within the watershed, and availability of water.

Since the current 303(d) List was approved in 1998, 21 TMDLs have been submitted to EPA for approval. The status of surface waters on Arizona's 1998 303(d) List is illustrated in **Figure 28**. More specific information is included in the assessment tables in Chapter V and summaries of the TMDLs are provided in the watershed reports in Volume II.

A Total Maximum Daily Load Analysis (TMDL)

A TMDL is a written, quantitative plan and analysis to determine on a pollutant specific basis the maximum loading a surface water can assimilate and still attain and maintain a specific water quality standard during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background and seasonal variation, with an allocation set aside as a margin of safety.


Colorado/Grand Canyon
Little Colorado/San Juan
Verde
Bill Williams
Middle Gila
Colorado/
Lower Gila
Salt
Upper
Gila
San
Pedro
Santa Cruz
TMDL Status:
Completed
In Progress
Scheduled or To Be Delisted
Streams
Watershed Boundaries
N
50 0 50 100 Miles

Status of TMDLs for Figure 28

Map #	TMDL	#`	Waterbody	#	Waterbody
1	Colorado River selenium (S)	30	Gila River copper (S)	56	Wet Beaver Creek turbidity (P)
2	Paria River turbidity, beryllium (P)	31	Gila River turbidity (S)	57, 58	Oak Creek turbidity (2 reaches) (S)
3	Chuar Creek turbidity (S)	32	Mineral Creek metals (P)	59	Oak Creek bact (C)
4	Colorado River turbidity (S)	33	San Pedro River bact, turbidity, nitrate (S)	60	Oak Creek nutrients (C)
5	Royal Arch Creek selenium (S)	34	San Pedro River bact, turbidity (S)	61, 62, 65	Verde River turbidity (3 reaches) (C)
6	Havasu Creek turbidity (S)	35, 36	San Pedro River, turbidity (2 reaches) (S)	63	Munds Creek bact, nutrients (C)
7	Virgin River turbidity (S)	37	Santa Cruz River turbidity (3 reaches) (S)	64	Bitter Creek metals (S)
8	Little Colorado turbidity (2 reaches) (C)	38	Santa Cruz River cyanide (S)	66	Gila River boron (P)
9	Nutrioso Creek turbidity (2 reaches) (C)	39	Sonoita Creek dissolved oxygen (P)	67	Agua Fria River turbidity (S)
10, 13	Little Colorado metals (2 reaches) (P)	40	Harshaw Creek metals (P)	68	Turkey Creek metals (P)
11	Silver Creek turbidity (S)	41	Three R Canyon metals (P)	69	Galena Gulch metals (S)
12	Show Low Creek dissolved oxygen, turbidity (S)	42	Alum Wash metals (P)	70	Hassayampa River turbidity (P)
14	Chevelon Creek turbidity (S)	43	Beaver Creek nutrients, turbidity (P)	71	Hassayampa River metals (P)
15	Colorado River turbidity (S)	44	West Fork of Black Creek turbidity (S)	72	French Gulch metals (P)
16	Big Sandy River turbidity (S)	45	Salt River turbidity (S)	73	Gila River boron (S)
17	Boulder Creek metals (P)	46	Canyon Creek turbidity (P)	74	Whitewater Draw metals (S)
18	Burro Creek turbidity (S)	47	Pinto Creek copper (C)	75	Mule Gulch metals (P)
19	Francis Creek turbidity (S)	48	Bloody Tanks Wash copper (S)	76	Rainbow Lake nutrients (C)
20, 21	Gila River turbidity (2 reaches) (S)	49, 50	Pinal Creek metals (S)	77	Luna Lake nutrients (C)
22, 23	San Francisco River turbidity (2 reaches) (S)	51	Tonto Creek turbidity (S)	78	Pena Blanca lake mercury (C)
24	San Francisco River turbidity, bact (S)	52	Tonto Creek nutrients (P)	79	Arivaca Lake mercury (C)
25	Blue River turbidity (S)	53	Christopher nutrients (P)	80	Pecks Lake nutrients (C)
26, 27, 28	Gila River turbidity (3 reaches) (S)	54	Middle Gila pesticides (10 reaches and 2 lakes)(P)	81	Stoneman Lake nutrients (C)
29	Eagle Creek turbidity (S)	55	Beaver Creek dissolved oxygen, turbidity (P)	82	Whitehorse Lake nutrients (P)
				83	Bartlett Lake turbidity (S)

(C) = completed, (P) = in progress, (S) = scheduled or delisting based on investigation

The Proposed 2002 303(d) List – In accordance with Arizona Revised Statute (49-232.A), the proposed 303(d) List is submitted to EPA following public review and publication of the list and response to comments in the Arizona Administrative Register. The proposed 2002 303(d) List is included in Chapter V of this report along with a priority ranking and schedule for completing each TMDL on the list.

The TMDL statute provides any party that submits written comments on the draft list a process to challenge a surface water listing. Any challenged listing will not be included on the initial submission to EPA, but may be subsequently submitted if the listing is upheld in the director's final administrative decision.

Normally the 303(d) List is due to EPA on April 1st of each even-numbered year. However, EPA postponed the 2002 delivery data to October 1 for states willing to make an integrated assessment and listing report, such as this report. This consolidated report will be available at ADEQs web site in Adobe PDF format at: http://www.adeq.state.az.us/environ/water/assess/.

More Information --For more information regarding Arizona's TMDL Program, contact Nancy LaMascus, TMDL Unit Manager, at (602) 771-4468 or 1-800-234-5677 ext. 4468. Copies of the 1998 303(d) List and report are available by contacting the program and are also downloadable from the ADEQ web site in Adobe PDF format at: http://www.adeq.state.az.us/comm/download/water.html (scroll down to Hydrological Support and Assessment).

Cleaning up contaminated sites.

State and Federal Superfund Programs -- In conjunction with the EPA, ADEQ's Waste Programs Division is responsible for cleanup at most contaminated sites in Arizona. These sites are known to have contaminated soil and/or ground water, and in a few cases surface waters**.** Cleanup occurs under action of the following three programs:

- Federally funded Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), also referred to as the federal Superfund Program;
- Arizona funded Water Quality Assurance Revolving Fund (WQARF), also referred to as the State Superfund Program; and
- Department of Defense (DOD) funded sites in the DOD Program.

Currently there are ten (10) federal Superfund sites known as National Priority List (NPL) sites, thirty-three (33) WQARF sites and twelve (12) DOD sites in Arizona **(Figure 29)**. ADEQ provides oversight, local expertise, management, and technical assistance in cleaning up of all of these contaminated sites. As indicated in **Tables 30, 31, and 32,** these sites are contaminated by a variety of pollutants including: volatile organic compounds (e.g., solvents), metals, petroleum products, buried wastes, and buried ammunition, and other hazardous substances.

Additional sites are being considered for inclusion on the federal or state Superfund lists. To be added to the state WQARF registry, a site must be scored, owners and operators of the site must be notified, and the public must be provided with a 30-day comment period. To be added to the federal National Priority List a preliminary assessment and site investigation is conducted. If the site has a confirmed release to the environment considered to be a risk to public health or the environment according to the Hazard Ranking System, the site may be added to the National Priority List.

Table 30. Federal National Priority List (Superfund Sites)

Watershed	Map #	NPL Sites	Pollutants and Media Affected
CLG	1	Yuma Marine Corps Air Station	GW -- VOCs, petroleum hydrocarbons Soil -- asbestos containing material
MG	2	19th Avenue Landfill	GW -- VOCs (DCE), metals, beta-radiation Soil -- VOCs (ethyl benzene, 1,4-dichlorobenzene, xylenes, toluene)
MG	3	Hassayampa Landfill	GW -- VOCs Soil – VOCs, metals, pesticides, lime waste
MG	4	Indian Bend Wash North	GW -- VOCs (TCE)
MG	4	Indian Bend Wash South	GW – VOCs (TCE) Soil – VOCs, cyanides, acids, chromium, lead
MG	5	Luke Air Force Base	Site delisted in 2002.
MG	6	Motorola 52nd Street	GW -- VOCs (TCE)
MG	7	Phoenix-Goodyear Airport South	GW – VOCs (TCE), chromium Soil -- cadmium and chromium
MG	7	Phoenix - Goodyear Airport North	GW -- VOCs (TCE, perchlorates) Soils – VOCs (TCE)
MG	8	Williams Air Force Base	GW and Soil -- Organic solvents, paint strippers, petroleum products, jet fuel, metals plating wastes, hydraulic fluids, pesticides, radiological wastes
SC	9	Tucson International Airport Area	GW -- VOCs (TCE, DCE) chloroform, chromium Soils – Polychlorinated biphenyls
SC	9	162nd Air National Guard	GW and Soil -- VOCs (TCE)
SC	9	Raytheon Air Force Plant #44	GW and Soil -- Metals, VOCs
SP	10	Apache Powder	GW -- Arsenic, fluoride, nitrate, perchlorate SW -- Dinitroglycerine (DNT) Soil -- arsenic, barium, metals, nitrate, vanadium pentoxide, trinitroglycerine (TNT)

See table footnotes on page 11.

Table 31. Department of Defense (DOD) Sites

Watershed	Map #	DOD Sites	Pollutants and Media Affected
CLG	44	Barry M. Goldwater Range	Soil -- Waste, spent munitions, chlordane
CLG	45	Yuma Army Proving Grounds	GW and Soil -- Petroleum hydrocarbons, VOCs, SVOCs, metals
CGC	53	Kingman Airport	
MG	46	161st Air National Guard	GW and Soil -- Petroleum products, VOCs (benzene)
MG	47	Gila Bend Auxiliary Air Field - (Site Closed)	Soil -- Petroleum hydrocarbons
MG	48	Papago Military Reservation	GW and Soil -- Ammunition and explosives, lead, petroleum hydrocarbons
Salt	54	Waterdog Recreational Annex	GW and Soil – Petroleum hydrocarbons
SC	49	Davis Monthan Air Force Base	Soil -- Petroleum waste, aluminum dross, jet fuel
SP	50	Fort Huachuca	GW and Soil -- Leaking Underground storage tanks and solid waste disposal
UG	55	Safford Military Range	Soil – lead
VD, LCR	51	Camp Navajo	GW and Soil – metals, VOCs, SVOCs, pesticides, constituents of explosives
VD, CLG	52	Naval Observatories (in Flagstaff & Sentinel)	

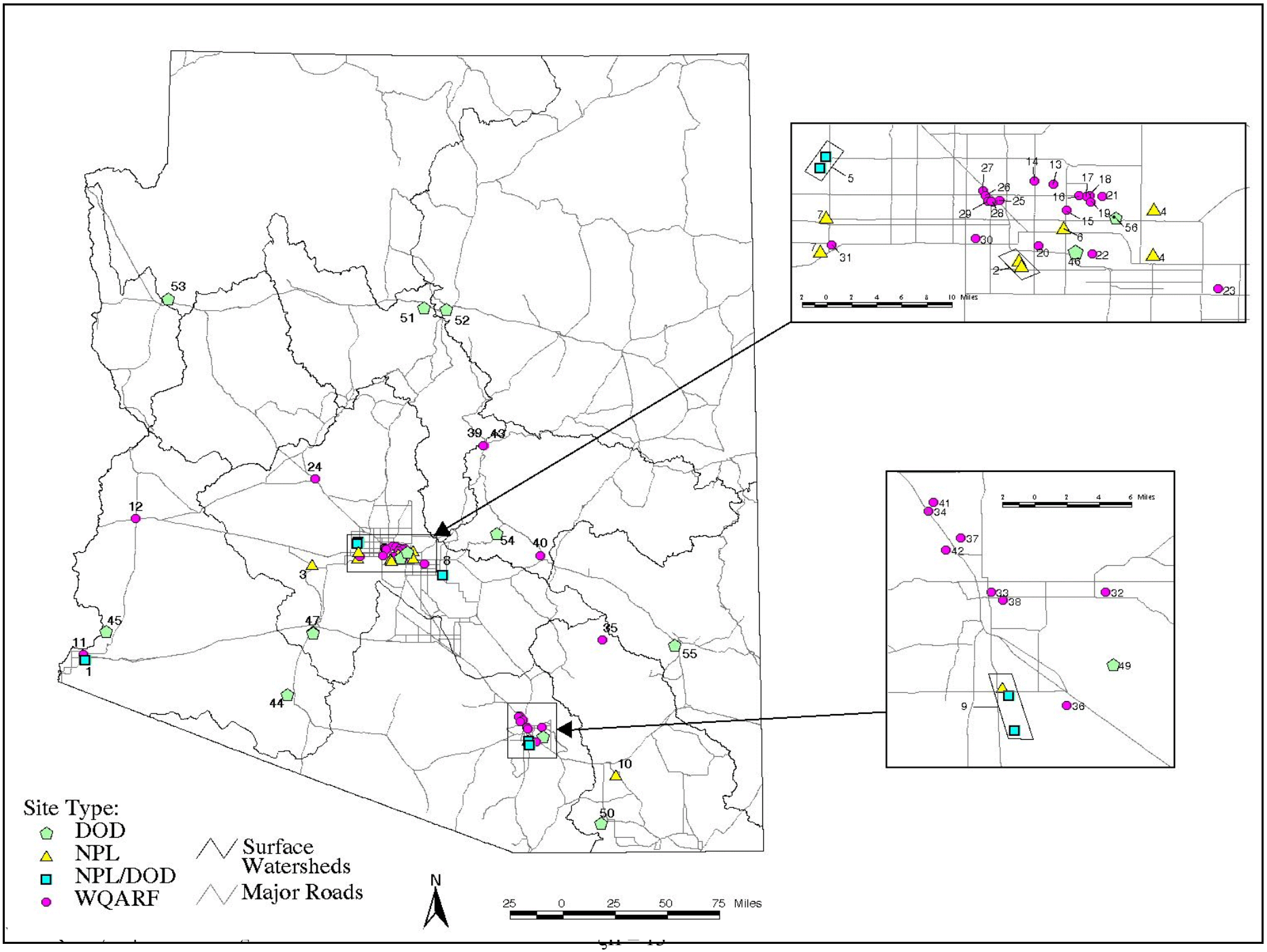
See table footnotes on page 11.

Table 32. WQARF Sites (State Superfund Sites)

Watershed	Map #	WQARF Site *	Pollutant(s) and Media Affected
CLG	11	20th Street and Factor Avenue	GW -- VOCs (PCE)
CLG	12	Tyson Wash	GW -- VOCs (PCE), nitrate
MG	13	16th Street and Camelback	GW – VOCs - PCE
MG	14	Central and Camelback	GW -- VOCs (PCE), MTBE, BTEX
MG	15	East Central Phoenix – 24th Street and Grand Canal	GW -- VOCs (PCE)
MG	16	East Central Phoenix – 32nd Street and Indian School Road	GW -- VOCs (PCE)
MG	17	East Central Phoenix – 38th Street and Indian School Road	GW -- VOCs (PCE)
MG	18	East Central Phoenix – 40th Street and Indian School Road	GW -- VOCs (PCE)
MG	19	East Central Phoenix – 40th Street and Osborn Road	GW -- VOCs (PCE)
MG	20	East Washington Fluff	Soil -- Lead, polychlorinated biphenyls (PCBs)
MG	21	East Central Phoenix – 48th Street and Indian School Road	GW -- VOCs (PCE)
MG	22	Estes Landfill	GW – VOCs (vinyl chloride, DCE, TCE, benzene, bis (2-ethylhexyl) phthalate); arsenic, barium, chromium, lead, manganese, and nitrate. Soil – arsenic, lead, thallium
MG	33	7th Street and Arizona Avenue	GW -- VOCs (TCE, PCE, cis-1,2-DCE)
MG	23	South Mesa	GW -- VOCs (PCE)
MG	24	Vulture Mill	Soil -- Metals (lead)
MG	25	West Central Phoenix – East Grand Avenue	GW and Soil -- VOCs (TCE, PCE, 1,1-DCE, 1,1-DCA, vinyl chloride)
MG	26	West Central Phoenix – North Canal Plume	GW and Soil -- VOCs (TCE, PCE 1,1-DCE, 1,1-DCA, vinyl chloride)
MG	27	West Central Phoenix – North Plume	GW and Soil -- VOCs (TCE, PCE, 1,1-DCE, 1,1-DCA, vinyl chloride)
MG	28	West Central Phoenix – West Grand Ave.	GW and Soil -- VOCs (TCE, PCE, 1,1-DCE, 1,1-DCA, vinyl chloride)
MG	29	West Central Phoenix – West Osborn Complex	GW and Soil -- VOCs (TCE, PCE, 1,1-DCE, 1,1-DCA, vinyl chloride)
MG	30	West Van Buren	GW -- VOCs (TCE, PCE)
MG	31	Western Ave. Plume	GW -- VOCs (PCE)
SC	32	Broadway-Pantano	GW -- VOCs (TCE, PCE, vinyl chloride)
SC	34	El Camino del Cerro	GW and Soil -- VOCs (TCE, PCE, vinyl chloride, benzene, methane)
SC	36	Los Reales Landfill	GW -- VOCs (TCE, PCE, Freon 11 and 12, chloroethane, DCE, methylene chloride, DCA)
SC	37	Miracle Mile	GW – chromium, 7 VOCs including TCE
SC	38	Park-Euclid	GW -- VOCs (TCE, PCE, 1,2-DCE), diesel product
SC	41	Shannon Road - Rillito Creek	GW -- VOCs (TCE, PCE)
SC	42	Silverbell Jail Annex Landfill	GW -- VOCs (TCE, PCE, vinyl chloride, Freon 11 and 12, methylene chloride, cis-1,2-dichloroethene)
SP	35	Klondyke Tailings	GW, SW, and Soil -- Metals
SR	40	Pinal Creek	GW, SW, and Soil: Metals, fluoride, sulfate, sulfuric acid
VD	39	Payson PCE	GW -- VOCs (PCE)
VD	43	Tonto and Cherry	GW -- VOCs (PCE)

* GW = ground water contamination, SW = surface water contamination
* VOC = volatile organic chemical, SVOC = semi-volatile organic chemical, TCE = trichloroethene, PCE = tetrachloroethane, DCE = dichloroethene,
DCA = dichloroethane, DCB = dichlorobenzene, MTBE = methyl tertiary butyl ether, BTEX = combination of petroleum hydrocarbons (benzene, toluene, ethylbenzene, xylene)

Watersheds: BW = Bill Williams, CLG = Colorado Lower Gila, LCR = Little Colorado-San Juan, MG = Middle Gila, Salt, SC = Santa Cruz-Rio Magdelena-Rio Sonoyta, SP = San Pedro-Willcox Playa-Rio Yaqui, UG = Upper Gila,
VD = Verde


Site Type:
DOD
NPL
NPL/DOD
WQARF
Surface Watersheds
Major Roads
N
25 0 25 50 75 Miles
2 0 2 4 6 8 10 Miles
2 0 2 4 6 Miles

Underground Storage Tanks -- The majority of underground storage tanks in Arizona contain petroleum compounds, such as gasoline and diesel fuels. ADEQ has programs are to prevent, detect, and clean up releases that contaminate soil and water, and through the State Assurance Fund, provides financial assistance to help pay clean up costs. Since ADEQ's Underground Storage Tank Program began in 1987, 7,838 underground storage tank leaks have been reported. As of 2001, 5,273 cleanups have been documented. Of the remaining sites, only 1,133 have or may have contaminated ground water.

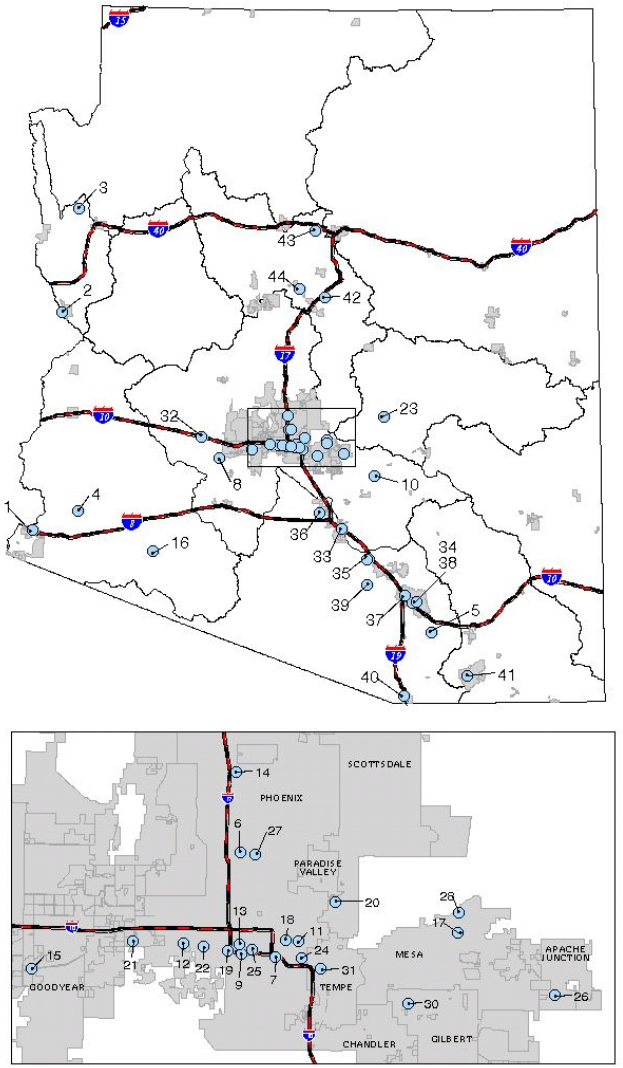
As of June 2001, ADEQ was tracking approximately 9,360 facilities with 27,500 associated underground storage tanks. However, of the 9,360 facilities only 2,950 have active tanks (19,360 of the 27,500 registered tanks are inactive). Further information about this program can be obtained at ADEQ's web site: http://www.adeq.state.az.us or by calling (602) 771-4322.

RCRA Hazardous Waste Contamination Sites -- The enactment of the federal Resource Conservation and Recovery Act (RCRA) in 1976 created a federal regulatory program for managing hazardous waste handlers in order to protect human health and the environment. This program was delegated to Arizona with EPA oversight through the Arizona Hazardous Waste Management Act of 1980. Handlers include generators, transporters, and facilities for treatment, storage, and disposal.

RCRA is coordinated with CERCLA (the federal Superfund Program) to regulate handlers and oversee the clean up of contaminated sites. Releases from improper generation, transportation, and disposal activities have lead to significant contamination of surface and ground water, soil, and even air in Arizona **(Table 33 and Figure 30).**

Table 33. RCRA Remediation Sites

Map	Site Name	Media	Watershed



GW = Ground water, SW = Surface Water
CLG = Colorado Lower Gila, MG = Middle Gila, SC = Santa Cruz-Rio Magdalen-Rio Sonoyta, SP = San Pedro-Willcox Playa-Rio Yaqui, VD = Verde

How is Arizona working with Mexico to improve water quality?

Unreliable water supply and water pollution are persistent environmental and public health problems in the United States and Mexico border region. Insufficient wastewater treatment, disposal of untreated discharges, and inadequate operation and maintenance of treatment plants endanger the health of the border communities. Moreover, the lack of suitable catchments, treatment, and distribution systems for potable water are serious public health issue.

US and Mexico Border XXI Program -- The Border Project area, illustrated in **Figure 31**, extends 60 miles north and south of the Mexico - Arizona border. Binational water infrastructure projects for potable water and sanitation have been undertaken pursuant to the 1944 International Boundary and Waters Treaty. Many federal, state and local institutions and agencies participate in these border area efforts. Specifically, the International Boundary and Water Commission (IBWC), the National Water Commission (CNA) [Mexico], USEPA, the Border Environment Cooperation Commission (BECC) and the NADBank have been collaborating on the planning, financing, and implementation of these projects. Efforts have been coordinated through the United States and Mexico Border XXI Program. This five-year program, ended in October 2001, will be continued by both countries for the coming years. Binational meetings are taking place to shape the future of this program. Arizona is intensively participating in this planning process.

One goal of the Border XXI Program is to put in place or replace inadequate infrastructure so that treated wastewater effluent from municipal and industrial sources will not degrade the surface water receiving the effluent. To demonstrate the effectiveness of these projects, baseline conditions of the surface water receiving effluent flows were established to determine the future impact of effluent once the project is in place.

The effects of these international cooperative projects on improvements in water quality are currently unknown since most are in the planning or construction stage. However, work is underway to characterize surface waters in the border region and to monitor water quality so that it will be possible to determine whether an implemented project has achieved its stated objectives, and to be able to improve or change the project to further improve water quality.

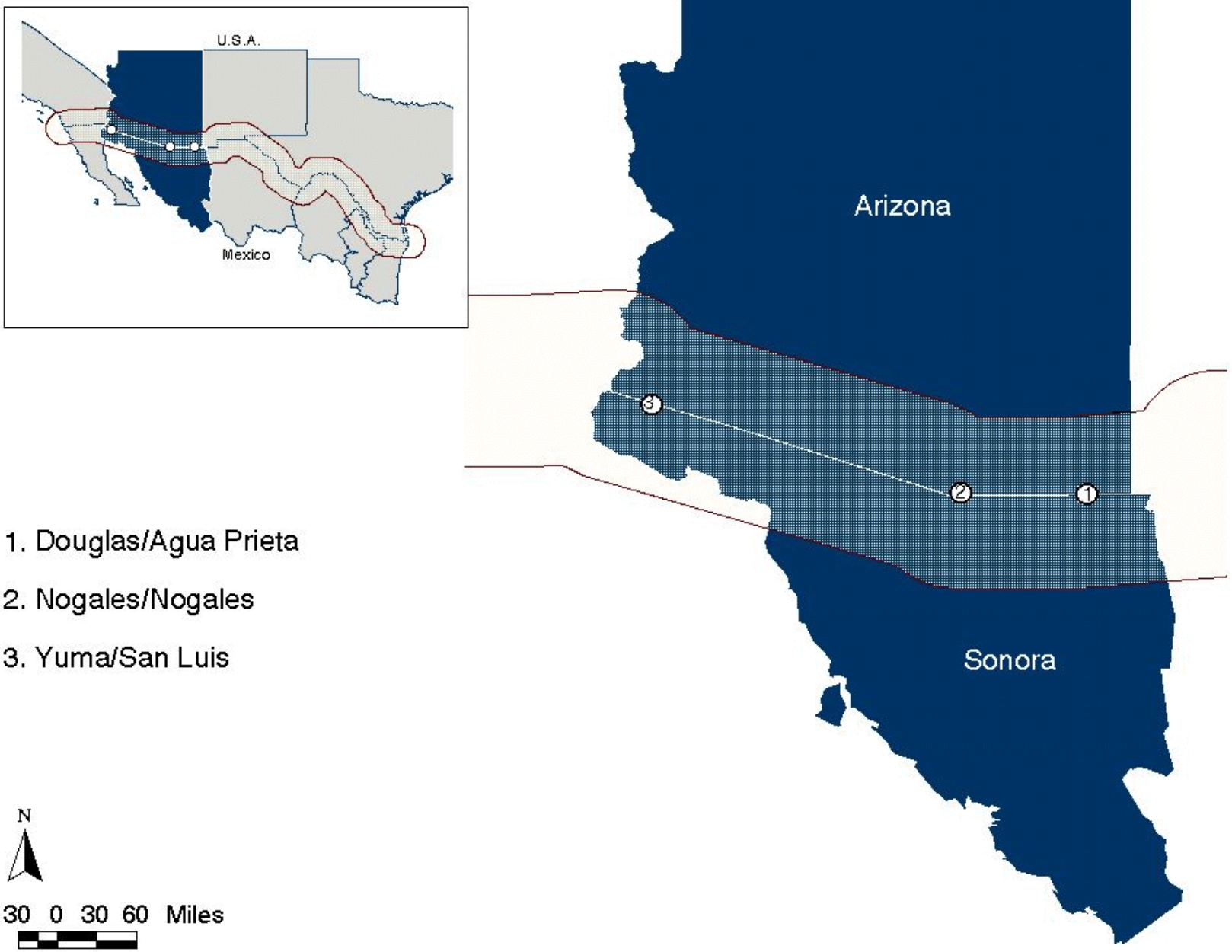
Working in the border region is complicated by overlapping functions in the many agencies and institutions involved in the process along with national differences in relevant legislation. Increased communication, cooperation, and coordination are essential to the success of this process.

Nogales International Wastewater Treatment Plant -- The Nogales Wastewater Treatment Plant provides wastewater treatment for the cities of Nogales, Arizona and Nogales, Sonora. This plant, which was issued a new NPDES permit in 2001 from EPA, is being expanded to accommodate increase sewage flows from both cities. The plant has also applied for an Aquifer Protection Permit from ADEQ.

A newly expanded plant is expected to be in operation in 2004. The NPDES permit requires the implementation of an industrial wastewater pretreatment program for both cities. Nogales, Arizona already has a pretreatment program in place, and ADEQ will be supporting the state of Sonora in the implementation of pretreatment activities for the city of Nogales, Sonora under a Memorandum of Understanding that was signed in June 2001 between both states.

Douglas Wastewater Treatment Plant -- The City of Douglas, Arizona is securing an Aquifer Protection Permit from ADEQ for its wastewater treatment operation. This plant does not need an NPDES permit since the treated effluent is being discharged directly into Mexico for reuse purposes. Negotiations are underway to secure an Aquifer Protection Program Permit and select the level of wastewater treatment for this plant although Class C effluent is being considered at Mexico's request. The proposed use for this effluent by Mexico would be as a coolant for power plant operations in Agua Prieta, Sonora where additional treatment would be required.

Power Plants and Effluent -- The shortage of energy in the western region has originated the planning and construction of power plants on both sides of the border. A projected 500-megawatt plant in Nogales, Arizona (to export energy to Mexico), a phased 1275 megawatt plant in Agua Prieta Sonora, a 2000-MW plant in San Luis RC, Sonora, and a 600 megawatt plant in Yuma, Arizona are being considered. Treated effluent from wastewater treatment plants located in the border region is being considered for power plant cooling systems. Active negotiations on the sale of trans-boundary treated effluent (quantity and quality) are taking place for some of these power plants projects.


U.S.A.
Mexico
Arizona
Sonora
1
2
3
1. Douglas/Agua Prieta
2. Nogales/Nogales
3. Yuma/San Luis
N
30 0 30 60 Miles

Water Quality Monitoring Projects in Arizona's Borderlands – ADEQ and the University of Sonora (UNISON) signed a Memorandum of Understanding in June 2001 to perform water quality sampling activities in the trans-boundary portions of binational watersheds of the Sonora border region. In Arizona, these binational surface water basins include: San Pedro, Rio Yaqui, Santa Cruz, Rio Magdalena and Lower Colorado River. These water quality projects will support border activities such as the development of the surface and ground water quality indicators for the border region. This agreement also provides technology-transfer opportunities where the Arizona Department Health Services State Laboratory can provide guidance in developing UNISON's analytical capabilities.

Several monitoring studies have occurred in the trans-boundary region in the recent past including the following studies:

- **Lower Colorado River Study --** In 1994, sites throughout the lower Colorado River basin were sampled and analyzed to determine concentrations of chemical pollutants and effects on aquatic organisms. A final report summarizing the results by the IBWC was not released until October 2001.

- **Aqua Prieta, Cananea, and Naco water studies** -- Water quality for the municipalities of Agua Prieta, Cananea, and Naco Sonora, Mexico was studied from 1996 through 1998. Results have indicated exceedances of the Mexican Water Quality Criteria for heavy metals (cadmium, chromium, copper, iron, manganese, nickel, lead and zinc), nitrates, sulfates, and fluorides in the mining and municipal discharges leading to the headwaters of the San Pedro River. The study did not find any exceedance of these parameters in the San Pedro River sampling points located near the international border. These monitoring studies also detected trichloroethene (a volatile organic chemical) in a public supply well located in Agua Prieta very close to the international border. Additional monitoring is being planned for this area with a grant from the USEPA to the local non-governmental organizations (with ADEQ support) to locate the possible sources of TCE in the area.

- **Santa Cruz River studies --** Two studies have been performed to evaluate water quality in the Santa Cruz River. The US Fish and Wildlife Service has completed a toxicity study of ambient water above and below the Nogales International Wastewater Treatment Plant discharge (King et al., 1999). A volunteer organization, known as the Friends of the Santa Cruz River, also completed a water quality study (ADEQ, 1995) and has continued to monitor the upper Santa Cruz and its tributaries.

- **Nogales Wash Study --** A binational study of ground water quality along the alluvial aquifer of Nogales Wash was initiated in 1996. Monitoring wells have been placed on both sides of the border and soil and ground water samples have been collected. Interpretation of the data indicates that ground water exceeded both Arizona and Mexico water quality standards for nitrate and fecal coliform. An organic solvent, tetrachlorotethylene (PCE), was also detected in concentrations exceeding Mexico's standards in Sonora but below Arizona's standards in Arizona. The contaminant distribution suggested the existence of a PCE plume in Sonora. In addition, arsenic levels detected in Arizona monitoring wells exceeded the Arizona Aquifer Water Quality Standards. (Arsenic contamination was detected in monitoring wells, not in drinking water wells.). Additional soil gas survey activities were performed at selected sites in November 2000 by the EPA Superfund Program in conjunction with ADEQ and the Mexican agencies on both sides of the border. These efforts attempted to locate potential sources of PCE contamination. Low levels of PCE were found at sites located in Nogales, Sonora. In addition, public drinking water supply wells and other wells were sampled in Nogales, Arizona in November 2000 and in June 2001 under the EPA Superfund Program. Preliminary data indicates still low levels of PCE contamination persists in monitoring wells.